SECTION VIII

SEPTIC SYSTEM MONITORING

A. INTRODUCTION

Properly operating onsite wastewater disposal systems usually contribute very little to the nutrient budget of lakes (Lee, et al. 1978). In contrast, faulty systems contribute a significant nutrient load which can stimulate the development of aquatic primary producers to nuisance densities (Kerfoot, 1979). Total phosphorus loads associated with domestic wastewater (kitchen, toilet, bath, and laundry) can be as much as 1.5 kg/capita/yr (Ligman, et al., 1974). Faulty septic waste disposal systems located close to the shoreline could therefore have a serious impact on the trophic status of the lake.

In many lakefront developments, failing septic systems are often attributed to oversaturation of the leach field due to a seasonal elevation of water table height, hydraulic overloading of the system due to overcrowding of vacation homes and conversion of seasonal dwellings to permanent dwellings, or the formation of clogging mats in the leach field which significantly impair wastewater percolation. These problems are often compounded by installation of systems of improper design or capacity, and by use of septic systems in areas with soils of poor absorptive quality. All the above conditions reduce the ability of the soils to properly remove nutrients by sedimentation, absorption, filtration or biochemical oxidation (Otis, 1979). The area in immediate proximity to the lake's shoreline will also be more sensitive to these conditions due to water table height and limited soil depth available for bacterial degradation and soil absorption (Kerfoot, 1980). This may result in the discharge of waste-contaminated groundwater plumes from these shoreline dwellings and the localized elevation of sediment-nutrient concentrations. In turn, by reducing or eliminating such discharges noticeable improvements in water quality and substantial reduction in localized plant growth can be garnered (Otis, 1979).

B. DENSITY OF SEPTIC SYSTEMS

Virtually the entire shoreline of Lake Hopatcong and its feeder lakes, Lake Shawnee and Lake Winona, has been developed as high or low density residential housing. Often, the developed areas of the lake have housing which extends three tiers or more from the lake's shore. The majority of dwellings are single family, permanent residences and all use onsite disposal systems (septic systems) for the treatment of domestic wastes. This degree of lakefront development carries with it the potential for the export of significant nutrient loads of septic origin.

Some of the more heavily developed areas of the lake's shoreline are the communities of Lake Shawnee, Woodport North, Brady Park, Waterways, East Shores, Byram Cove, Crescent Cove, River Styx, Ingram Cove, Point Pleasant south to the State Park, Landing channel, and King Cove.

C. COMPATIBILITY WITH SOILS

The predominate soil types occurring along the shoreline of Lake Hopatcong are the Rockaway, Rockaway-rock outcrop, and Hibernia stony loam soils (SCS, 1975; SCS, 1976). These soils are characterized as being severely limited in terms of use in septic system leach fields. For the most part, the shallow depth to bedrock is responsible for this restriction. In addition, many of the developments occur in areas where the slope is fairly steep (8-15%) or in areas along the lake's shore where seasonally the water table is high. The combined effects of shallow soils, steep slope, and high water table make much of the area immediately surrounding the lake unsuitable for the use of onsite waste disposal.

D. SEPTIC SNOOPER STUDY RESULTS

In order to determine the importance of septic systems on nutrient loading to the lake, a portable fluorescence-conductivity meter, commonly called a "septic snooper", was used to detect improper domestic wastewater discharge. The discharge, referred to as a septic plume, is caused by the faulty operation of onsite disposal systems, and results from the active emergence of septic waste contaminated groundwater into the lake (Kerfoot, 1980). Under such conditions the septic effluent has not had sufficient time to percolate through the soils, and is usually characterized by elevated organic and inorganic concentrations.

Septic leachate entering the lake carries with it dissolved nitrate, ammonia, phosphate, and organic substances. These nutrients stimulate the growth of bacteria, algae and aquatic macrophytes. This can have serious effects on use of this water in recreational or potable water applications.

Septic leachate surveys were conducted of the entire shorelines of Lake Hopatcong and Lake Shawnee using an ENDECO 2100 Septic Leachate Detector System. As water is pumped through the "septic snooper", conductance and fluorescence are monitored continuously. In principal, wastewater effluent is partly comprised of a mixture of near UV fluorescent organics derived from laundry whiteners, surfactants and natural degradation products, and conductive inorganics, such as chloride (Cl^-) and sodium (Na^+). By monitoring these parameters in the form of fluorescence and conductivity, a leachate plume can be detected as it eminates from the shoreline. This results in three general conditions:

1. Elevated fluorescence
2. Elevated conductance
3. Elevated fluorescence and conductance

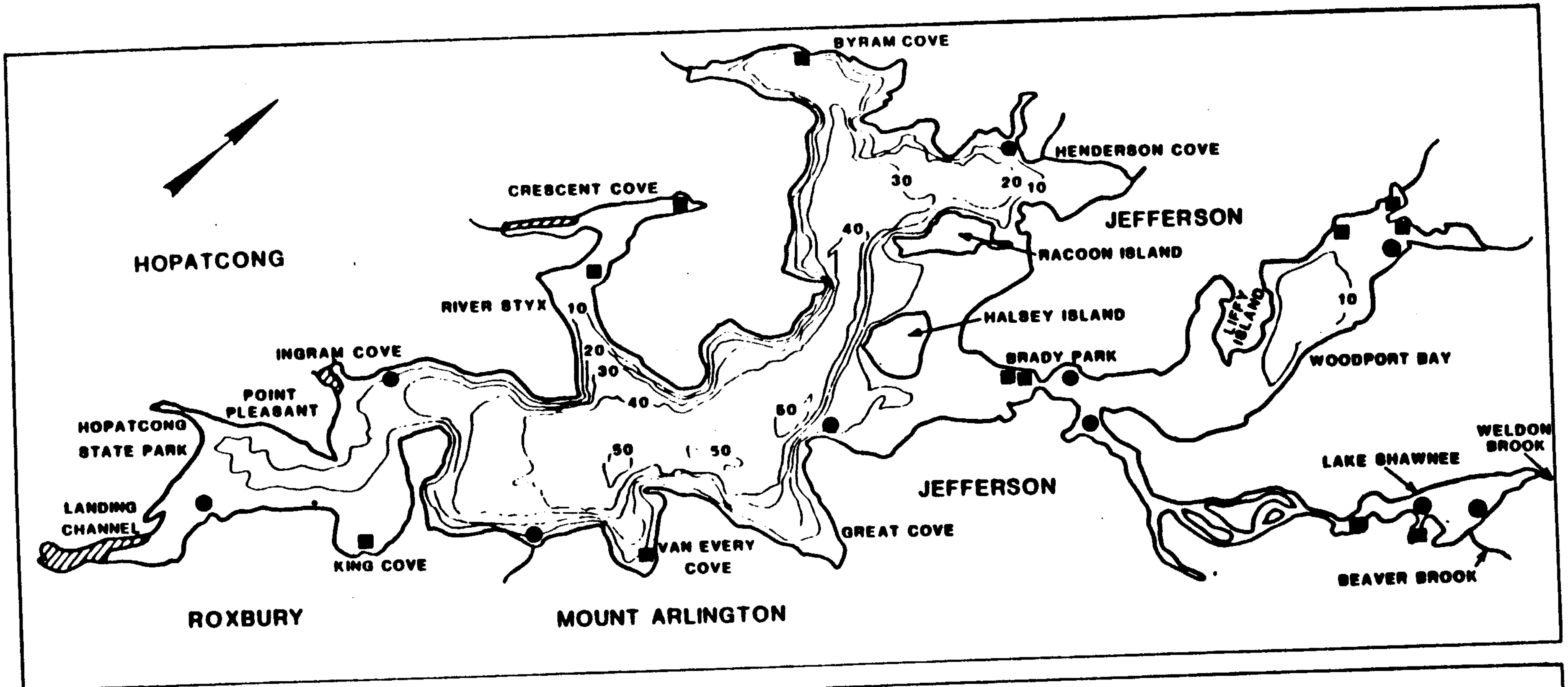
The third condition is indicative of septic contamination whereas the other two may indicate "grey water" contamination, groundwater intrusion, or discharge from streams, bogs, or marshes. At those sites where both fluorescence and conductivity were elevated, water quality and bacteriological samples were collected. Analysis of these samples help verify or refute the existence of a septic plume.

A number of plumes were encountered in the survey of Lake Shawnee and Lake Hopatcong. Plumes of both a discrete and a broad nature were observed. The former suggests that the septic inflow originates from a single dwelling, whereas the later suggests a wide scale failure of systems within that particular area.

The surveys of the Hopatcong, Roxbury, and Mt. Arlington shorelines were conducted in July and August of 1982. The surveys of the Jefferson and Shawnee shorelines were conducted in September of 1982.

In general, broad plumes were detected in areas where the housing density is high, particularly in coves or embayments in which water exchange is infrequent or restricted. The hydrodynamics of these embayments probably facilitates the retention of septic leakage and contributes, somewhat, to the elevated readings. However, not all embayments with restricted flushing characteristics displayed elevated readings. Rather, it was in those areas where the housing density was high that elevated "snooper" readings were recorded.

A total of 21 plumes were detected along the Lake Hopatcong shoreline and 6 along the Lake Shawnee shoreline (Figure 5). Of the 21 plumes detected in Lake Hopatcong, 7 were associated with groundwater intrusion or tributary inflow. The same conditions were responsible for 3 of the



LEGEND

■ DISCRETE SEPTIC PLUME

▨ BROAD SEPTIC PLUME

● NATURALLY INDUCED PLUME (GROUNDWATER, STREAM, MARSH, ETC.)

FEET
0 1000 2000

0 200 400
METERS

DEPTHS IN FEET

LAKE HOPATCONG REGIONAL PLANNING BOARD

LAKE RESTORATION AND MANAGEMENT STUDY

FIGURE 5
OCCURENCE OF SEPTIC PLUMES IN LAKE HOPATCONG AND LAKE SHAWNEE

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plumes detected in Lake Shawnee. Three of the plumes detected in Lake Hopatcong were very broad, indicating the occurrence of large scale septic failures in those areas. Specifically, the southwestern side of Crescent Cove, most of Ingram Cove, and most of Landing channel displayed such conditions (Figure 5). The remaining plumes were of the discrete variety with some being associated with the seepage or discharge of grey water effluent into the lake.

In Lake Shawnee, the four detected septic plumes were of the discrete variety. The plume of most notable magnitude was observed in an embayment along the eastern shore of the lake. This plume may actually represent the discharge from the Arthur Stanlick School Sewage Treatment Plant. Effluent from this STP is discharged to a small marsh which empties into Lake Shawnee in the vicinity where the plum was detected. The remaining plumes were of much lower magnitude (Figure 5).

Water quality and bacteriological samples were taken at the site of high magnitude plumes to help support the finding of the "septic snooper" data. In most cases, the concentration of nutrients (total phosphorus, nitrate, nitrite, or ammonia) were not significantly different than that commonly recorded for the surface waters of either lake. However, the bacteriological samples did yield fecal coliform and fecal streptococcus counts greater than normally observed in the lake at that time of year. The total plate counts were too low to make any valid conclusions on the source of the bacteria as based on fecal coliform/fecal streptococcus ratios.

E. INFRARED AERIAL ANALYSIS

Potentially failing septic systems can also be identified by means of infrared aerial analysis. The leach fields of failing systems are detected due to their more intense red hue. The infrared analysis of the Lake Hopatcong watershed was impeded by the poor quality of the photographs which were inadvertently overexposed. As a result, only overt failures could be identified. A total of 33 were observed along the Lake Hopatcong shoreline. A concurrent study of the Lake Shawnee area disclosed an additional 4 overt failures (Elam and Popoff, in prep.)

F. SEPTIC LEACHATE CONTRIBUTIONS TO LAKE HOPATCONG

On the basis of infrared and septic snooper data, questionnaire responses, geohydrology data, and soil permeability characteristics, it is concluded that there exists a serious problem related to the use of onsite disposal systems in the Lake Hopatcong watershed. Septic failures have contributed to the development of dense growths of aquatic macrophytes. Septic related impacts tend to be most pronounced in those areas where broad septic plumes were detected. Specifically, Crescent Cove, Ingram Cove and Landing Channel are three areas of the lake where wide scale septic inputs are known to occur. It is in these same areas that very dense beds of Myriophyllum, Vallisneria and Potamogeton are observed. It is recognized that the limited flushing of these embayments exacerbates the septic failure problem. However, the nature of the soils, height of the water table, and the density of homes along most of the lake's shoreline presents a situation whereby septic failures of notable severity could occur in any of the highly developed areas of the lake. The importance of septic leachate on the nutrient budget and eutrophication of the lake is probably greatest in the spring when, as a result of elevated water table height and poor soil permeability, the effective sorption of leachate nutrients by soils during percolation is reduced. Unfortunately, this is the same time of year when macrophyte metabolism and growth is occurring at a maximum rate (Wetzel, 1975).

The nutrient load contributed to the lake as a result of onsite disposal systems was quantified using the methodology outlined in NES Working Paper #175 (USEPA, 1976). The number of dwellings within 100-200 m of the lake's shoreline was determined from current census data (U.S. Dept. of Commerce, 1980), and actual counts from aerial photos. This information was supplemented by data collected in conjunction with the 201 Municipal Sewage Facility studies presently being conducted in the watershed of Lake Hopatcong (PAS, in prep; Elam and Popoff, in prep).

Particular attention was paid to the number and location of septic failures reported in the Board of Health records of the municipalities surrounding the lake.

A total of 5400 units were found to occur within 100 meters of the lake's perimeter. For the Lake Hopatcong area, the average population density is 2.6 capita/dwelling (U.S. Dept. of Commerce, 1980). The total population living near the lake's shore is thus 14,040. The NES septic loading coefficients of 0.114 kg TP/capita/yr and 4.263 kg TN/capita/yr were utilized to calculate septic load. The resulting loads of TP and TN contributed by septic systems are computed to be 1600.6 kg and 59,852.5 kg respectively.

Although these loads may seem high, they were calculated using loading coefficients which assume that the septic systems in question <u>are operating properly</u>. In the Lake Hopatcong watershed, approximately 20% to 30% of the septic systems are suspected of operating faulty as based on septic snooper, aerial photography, Board of Health, and soil compatability data. Thus the loads generated by this study are reasonable, and probably slightly <u>underestimate</u> actual septic inputs to the lake.